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PRODUCTION SCHEDULING PRACTICE

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PRODUCTION SCHEDULING PRACTICE

LIEW KIAT JUANG

This project is submitted in partial fulfillment of

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Dedicated to My Parents

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ABSTRACT

Today's businesses are competing increasingly on time and quality. To remain competitive, proper production scheduling system is very necessary. Production scheduling is the activities performed in manufacturing companies to manage and control the execution of the production process. Resources are known as part of important component in production scheduling and it should be utilize wisely to meet organization's goal. Type of scheduling approach used may vary according to the production environment, management of the company and organization. The objective of this project is first to identify and investigate the factors that contribute to the problems/difficulties during production scheduling in the company under studied. Then the effects of poor production scheduling are studied. Next, type of scheduling technique used by the company under studied would be identified and recommendations are provided to solve the problems regarding production scheduling. The selected factory for the case study is ceramic tile manufacturer and distributor. Self observation and interviews are conducted to collect all the required data and information. The data and information are studied for the problems met during production scheduling and its effects then the suitable recommendations are suggested. From the results, the company is using Enterprise Resource Planning (ERP) System as the scheduling tool. ERP system itself is link to the sales department, scheduler, production personnel, work center manager, inventory section, and purchasing department. During the scheduling process, the company has met a lot of problems. The major problems faced are raw material problem, machine unavailability, raw material shortage, inaccurate information and poor performance feedback. It can be concluded that these problems have direct impact on production

and scheduling process. At the end of chapter, recommendations for each problem are provided.

ABSTRAK

Persaingan untuk menghasilkan produk yang berkualiti dalam masa yang ditetapkan semakin sengit di dunia perniagaan hari ini. Untuk mengekalkan kebolehsaingan, penjadualan pengeluaran amatlah diperlukan. Penjadualan pengeluaran merangkumi aktiviti-aktiviti yang dijalankan untuk mengurus dan mengawal pelaksanaan proses pengeluaran produk. Sumber-sumber merupakan komponen yang penting dalam penjadualan pengeluaran dan ia perlu digunakan dengan sewajarnya untuk mencapai matlamat sesebuah organisasi. Jenis kaedah penjadualan pengeluaran yang digunakan adalah berbeza mengikut persekitaran pengeluaran, cara pengurusan syarikat dan organisasi. Objektif projek ini adalah untuk mengenalpasti dan menyiasat faktor-faktor yang menyumbang kepada masalah-masalah semasa penjadualan pengeluaran. Kemudian, kesan-kesan dari masalah-masalah tersebut turut dikenalpasti. Seterusnya, jenis teknik penjadualan pengeluaran yang diamalkan oleh syarikat di bawah kajian dikenalpasti dan dikaji. Cadangan-cadangan dibuat untuk menyelesaikan masalah-masalah yang dihadapi. Syarikat yang dipilih untuk kajian tersebut adalah pembuat dan pengedar jubin seramik. Pemerhatian sendiri dan temu bual telah dijalankan untuk mengutip segala maklumat yang diperlukan. Maklumat tersebut telah dikaji setiap masalah yang dihadapi semasa penjadualan pengeluaran dan kesannya. Kemudian, cadangan-cadangan yang membina dan sesuai dicadangkan. Dari keputusan yang diperolehi, syarikat yang di bawah kajian menggunakan “Enterprise Resource Planning (ERP) System” untuk penjadualan pengeluaran. Sistem ERP merupakan satu rangkaian yang menghubungi jabatan jualan, penjadual, staf pembuatan, pengurus pusat kerja, seksyen inventori, and jabatan pembelian. Semasa proses penjadualan, syarikat tersebut telah menghadapi

banyak masalah. Masalah-masalah yang utama adalah masalah dengan bahan mentah, ketiadaan mesin, kekurangan bahan mentah, ketidaktepatan informasi dan maklum balas prestasi yang tidak memuaskan. Kesimpulannya, masalah-masalah tersebut telah membawa kesan yang buruk kepada proses pembuatan dan penjadualan. Cadangan-cadangan untuk masalah-masalah yang dihadapi telah dikemukakan di akhir bab ini.

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BPCS	Business Planning and Control System
CR	Critical ratio
EDD	Earliest due date
ERP	Enterprise Resource Planning
FCFS	First come, first served
FOR	Fewest operations remaining
GA	Genetic Algorithm
LS	Least Setup.
LWR	Least work remaining
MPS	Master Production Schedule
MRP	Material Requirement Planning
MRP II	Manufacturing Resource Planning
NQ	Next queue
OPT	Optimized Production Technology
RMSs	Reconfigurable Manufacturing Systems
SAP	Systems, Applications and Products in Data Processing
SPT	Shortest Processing Time.
SRI	Schedule Reliability Index
SSA	System Software Associates
ST	Slack time
ST/O	Slack time per operation
WIP	Work in Progress

CHAPTER 1

INTRODUCTION

1.0 Global Competitiveness

Today's businesses are competing increasingly on time and quality. Companies cannot survive if they fail to obtain competitive advantages by producing high quality products and services in shorter throughput time and quicker inventory turnover (Rahman, 1998). Current customers demand shorter lead times and higher product variety without making concessions on product price and quality. To remain competitive, manufacturing system needs to react adequately to perturbations on its environment and uncertainties in manufacturing processes (Kim et. al., 2001).

In meeting the customers' requirements (e.g. fast delivery time, low product cost, high product quality), proper production scheduling system is necessary. In most of the areas the temporal goals are most important, i.e., meeting the due dates is the main goal of scheduling, because this will satisfy the customers and enable the companies to response flexible to the customer demands (Sauer, 1999). As according to Sanmartf (1995), Wan and Usher (2005), production scheduling is very important in satisfying the demand for different products under certain constraints in the most efficient way. Production scheduling, which is a part of the planning and control of

individual production units, lies at the very heart of the performance of manufacturing organizations.

The need for efficient scheduling has greatly increased in recent decades owing to market demands for product quality, flexibility and order flow times (Paul, 1996). Tan and Souza (1997) also stated that scheduling is very vital in a manufacturing firm. It plays a crucial role in a wide variety of environments such as in most manufacturing and production systems as well as in most information-processing environments. In the current competitive environment effective scheduling has become a necessity for survival in the marketplace (Metaxiotis, Psarras and Askounis, 2001). For manufacturers in "make-to-stock," "build-to-order," and "build-to-forecast" environments, it's critical to properly allocate their limited equipment resource capacity. As according to Hussein (2005), system owners have to schedule the usage of their available resources in an efficient way to fully utilize its resources.

1.1 Definition of Production Scheduling

Production scheduling is the activities performed in manufacturing companies to manage and control the execution of the production process. The basic task is to perform the production as planned while at the same time trying to satisfy the overall goals of the company (Olofsson, 2004). Yadav et. al. (2000) defined production scheduling as a process to allocate available manufacturing resources for required production jobs and to identify the sequence and timing parameters to undertake these jobs. Production jobs are achieved from product designs. Limited resources

include equipment, manpower, raw materials, space in which to produce or store inventory, available capital, and so on.

Similarly, as according to Hussein (2005) and Sand et. al. (2000), scheduling is a decision-making process in assigning resources over time in order to perform a collection of competing activities to fulfill certain production goals or objective functions. Joao (2002) also mentioned about scheduling as a way to assign and sequence the use of resources effectively as to satisfy the production constraints and minimized production cost.

As it is mentioned by most of the authors, it can be concluded that resources are known as part of important component in production scheduling and it should be utilize wisely to meet organization's goal and according to Olofsson (2004), production resources are everything that is required to perform the production.

However, there is always confusion on difference between planning, scheduling and sequencing. According to Stoop and Wiers (1996), clear definitions for each of these functions are difficult to find, which holds especially for the demarcation between planning, scheduling and sequencing. Typically, the output of planning consists of material requirements in time. These requirements are passed to the lower control levels, i.e. scheduling. So, the output of planning, i.e. material requirements in time is the input of scheduling.

Production scheduling focuses on the allocation of finite resources to fulfill material requirements within individual production units. As described in previous

chapter, scheduling determines for each resource the points in time when operations are executed, under various constraints. After scheduling, the schedule is transferred to the production unit. The implementation of a production plan or schedule is often referred to as dispatching. As stated by Olofsson (2004), the general idea is that planning is done at a higher, aggregated level over longer time periods and that scheduling involves more details and is done over shorter time periods.

As defined by Stoop and Wiers (1996), at each production line, every time a job/batch product is completed, a decision has to be made about which order will be processed next; this decision is referred to as sequencing. The existence of an explicit sequencing decision on the shopfloor depends on how scheduling is carried out. Therefore a distinction is made between two possible aggregation levels of scheduling:

1. Resource level. Jobs are scheduled for each resource (workstation). This type of scheduling gives no sequencing decision freedom to the shopfloor.
2. Production unit level. Jobs are only scheduled for the total production unit. The operations of the job are not scheduled. This type of scheduling leaves the sequencing decision to the shopfloor.

According to theory, planning controls the inventory points in the goods flow and give material requirements to scheduling. The function then releases jobs to the shopfloor. Dependent on the level of scheduling, sequencing decisions are made on the shopfloor.

Developing a schedule involves designating the resources needed to execute each operation of the process routeing plan and assigning the times at which each operation in the routeing will start and finish execution (Tan and Souza, 1997). Haldun (2005) stated that development of production schedule is to serve as an instruction to the shop floor, causing the shop to execute events in the sequence and timing suggested in the schedule. Within all activities of production management, production scheduling is a major part covering planning and control functions (Schmidt, 1998). Some of functions which must be performed in scheduling and controlling a production operation as according to Metaxiotis, Psarras and Askounis (2001) are as following:

- Allocating orders, equipment and personnel to work centers or other specified locations
- Determining the sequence of orders performance
- Initiating performance of the scheduled work
- Production activity control

Metaxiotis, Psarras and Askounis (2001) have use 5 basic ontologies: order, activity, resource, product and constraint in describing the relationships in production scheduling domain as shown in **Figure 1**. According to Metaxiotis, Psarras and Askounis (2001), production scheduling is known as a process of feasibly synchronizing the use of resources by activities to satisfy orders over time. An order is an input request for one or more products, which designate the goods or services required. Satisfaction of orders centers on the execution of activities. An activity is a process that uses resources to produce goods or provide services. The use of resources and the implementation of activities are restricted by a set of constraints.

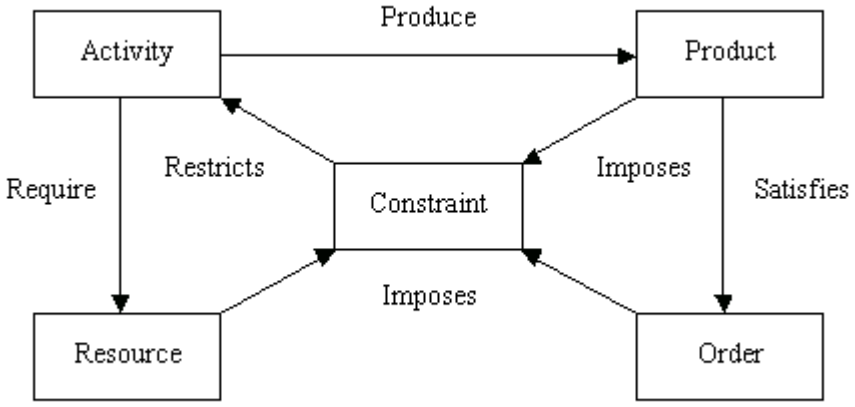

Figure 1: Production Scheduling Domain (Source: Metaxiotis, Psarras and Askounis, 2001)

Generally, production scheduling can be classified into online production scheduling and offline production scheduling. In online scheduling, which is also referred to as dynamic scheduling, the tasks are not known before starting the execution process and jobs arrive over time and the problem is solved without complete knowledge about the entire problem input or knowledge of future jobs (Schmidt, 2000). According to Schmidt again, online scheduling requires online algorithm, which do not generate a complete schedule but decide about the next step to be taken until scheduling environment changes again due to external events. While for offline scheduling or static scheduling, schedules are developed based on fixed production demands and fixed processing times over a scheduling period and it is assumed that the process will be operated exactly as scheduled (Ishii and Muraki, 1996).

How production scheduling is performed and the scheduling methods used, can vary a great deal between different production environments, from applying simple rules when choosing the next job to execute, to the use of advanced optimizing methods that try to maximize the performance of the given environment. It also depends on management of the company and the organization around the scheduling function. Type of scheduling technique used can also differ between companies and also between different users in the same company.

1.2 Characteristic of Production Environment

The types and amount of scheduling and production control efforts vary among the three types of production environments. As according to Dilworth (1993), each production environment has different characteristics as shown below:

Repetitive

It must deal with repetition of a few familiar jobs since it produces a standard product in relatively high volume. Process planning is very important because so many items will be run through the routing that is developed.

Batch

It must deal with a recurring variety of familiar jobs since it makes a variety of standard products by switching from one to another. It is more complex to schedule and control than a continuous facility of the same size. It involve wider variety of standard items, thus job planning and routing require more work. Much of the

complexity arises in determining the relative priority of the jobs because the mix of items at each work center may vary frequently.

Job Shop

It must deal with an ever-changing mix of unfamiliar jobs since it bids on custom products and may seldom repeat production of the same item. It usually involves the greatest complexity. A great deal of work must be done in job planning since such companies must plan each job that is bid in order to provide a safe estimate of the cost, yet a competitive price to the customer. Each schedule is a new problem because it is a new mix of tasks and amounts of work.

1.3 Problem Statements

In this section, we will discuss some of the problems faced by most of the manufacturing industries briefly. The major problems faced during production scheduling include the following:

1) The presence of multiple sources of uncertainty or unpredictability of production systems, both internal (e.g., machine breakdowns) and external (e.g., new order arrivals, surges in demand, order cancellations, delays in the development of new fixtures or delivery of raw materials) (Norman, 1998 and Sand et. al., 2000). According to Haldun (2005), the uncertainties faced in manufacturing operations have been a problem since the beginning of systemized manufacturing and remain so today. Balasubramanian and Grossmann (2002) also highlighted uncertainties as problem faced for most of the manufacturing company. As the uncertainty increases, the value of scheduling deceases (Olofsson, 2004). These

uncertainties prevent the execution of production schedule exactly as it is developed and complicating scheduling process (Tan and Souza, 1997).

2) The difficulty in obtaining an optimum scheduling performance since the possible solutions is so heavily constrained (Olofsson, 2004). John (2001) defined a constraint as "anything that limits the performance of a system relative to its goal". As according to Olofsson, constraints can be grouped into hard and soft, hard constraints are those that must be satisfied if the solution is to be feasible and soft constraints are those that are preferred to be satisfied but can be relaxed to find a solution. In scheduling, hard constraints are for example precedence relations between operations and the availability of materials and soft constraints are for example due dates that need to be relaxed because of missing materials or resource capacity that has to be increased by working additional shifts or overtime.
3) Scheduling techniques often do no work in practice. Because of complexity of scheduling in practice, implementation of scheduling techniques has created many problem and these techniques often changed by scheduler or do not carried out as exactly on the shop floor (Paul and Wiers, 1996; Metaxiotis, Psarras & Askounis, 2001 and Wiers, 1997).

Generally, as stated by Metaxiotis, Psarras and Askounis (1997), most scheduling problems are notoriously NP-hard or NP-complete, and it is said to be unsolvable as the number of possible schedules grows exponentially with a linear increase of resources or jobs to be planned as shown in **Figure 2**.